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ABSTRACT

Reported are the procedures, results, and conclusions of a study to determine the effects of available instances on the relationship of memory abilities to performance in a concept learning task. Subjects were 60 undergraduates from introductory educational psychology courses. Tests of six memory abilities were administered to subjects prior to their work with the task. The tests dealt with memory for symbolic and semantic units, classes, and implications. The task was a four-category, two dimensional conjunctive concept problem presented on computer terminals by the method of anticipation. Results indicated that (1) success in recalling previously presented instances and their correct categorization was most closely associated with the measure of memory for symbolic implications, (2) providing a previously presented instance did not significantly facilitate performance in the concept task, and (3) higher memory ability is reflected by more successful performance on the task. Two data tables are included in this report. Bibliography. (LC)

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# THE EFFECT OF AVAILABLE INSTANCES ON THE RELATIONSHIP OF MEMORY ABILITIES TO PERFORMANCE IN A CONCEPT LEARNING TASK[1,2]

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Recently, investigations concerned with the role of various intellectual abilities in different concept learning tasks (e.g., Bunderson, 1967; Dunham & Bunderson, 1968; Dunham, Guilford, & Hoepfner, 1968; and Lemke, Klausmeier, & Harris, 1967) have established that tests of short-term memory abilities are related to performance in concept learning tasks. This relationship could be interpreted as due to the necessity of recalling past instances in order to solve such tasks. For example, in multiple-category problems, in which S has been informed of the number of dimensions involved in the solution, he could begin by hypothesizing that a subset of the problem dimensions are the relevant ones. By comparing two instances, a decision could be made about the status of the hypothesis. If two instances were from the same category, and the values of the dimensions involved in the hypothesis were different, then the hypothesis could be rejected. Conversely, if two instances were from different categories, and the values were the same, the hypothesis could be rejected. Thus the solution of a multiple-category problem by the use of these rules would necessitate the recall of past instances.

Several investigators have experimentally reduced the necessity of recalling past instances by making various numbers of previously presented instances available to S. Such availability has consistently been shown to facilitate performance in concept learning tasks (Blaine, Dunham, & Pyle, 1968; Bourne,

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Goldstein, and Link, 1964; Pishkin, 1967; and Pishkin & Wolfgang, 1965). This result has usually been interpreted as a reduction in the memory requirement of the task. If Ss were using dimension selection rules such as those discussed, the reduction of the memory requirement would be due to Ss being provided with instances they would ordinarily be forced to recall for the use of the rules. Since availability reduces the memory requirement of the task, the relationship of memory abilities to performance in the task should similarly be altered. That is, the relationship between tests of memory ability and performance in a concept learning task should decrease when the memory requirement of the task is reduced. Thus, the availability of past instances should not only facilitate performance, but should also reduce the importance of memory abilities in concept learning performance.

## Method

Subjects. The Ss were 60 undergraduates from introductory educational psychology courses at The University of Texas at Austin.

Materials and procedures. Tests of six memory abilities from Guilford's Structure of Intellect model (Guilford, 1967; and Guilford & Hoepfner 1966) were selected on the basis of their possible relevance to the concept learning task. These tests were administered to all Ss in a group setting prior to their work with the task. The tests dealt with memory for symbolic and semantic units, classes, and implications. The six tests are listed in Table 1.

All of the concept learning materials, except for certain segments of the instructions, were presented on IBM 1050 computer terminals connected to an IBM 1440 system. The concept stimuli were typed out to S, and S in turn responded by typing in his response at the typewriter keyboard.

The task was a four-category, two-dimensional conjunctive concept problem presented by the method of anticipation. The stimuli consisted of the letters A through F which were always in alphabetical order, but each of the letters could appear in upper or lower case. The task for all Ss was to learn to categorize the instances based upon the upper and lower case combinations of the two relevant letters. The categories were designated 1, 2, 3, and 4.

The concept task was presented in two phases. The first phase consisted of 24 concept instances plus 12 of these 24 which were repeated within the first 24 with either 1, 2, or 3 intervening instances. It was assumed that Ss more capable of recalling past instances should respond correctly to a greater number of the repeated instances. In this way an attempt was made to assess the ability of Ss to recall previously presented instances. In the second phase, the availability conditions were introduced and corresponded to either zero or one previous instance available. Of the 60 Ss, 30 were randomly assigned to the zero availability condition and 30 to the condition which provided one available instance.

In the first phase, all instances were presented under the zero availability condition. At the end of the first 36 instances, Ss were branched to one of the availability conditions according to the previous random assignment. In the zero availability condition, instances were presented such that each instance was spaced under a facesheet before the next instance was presented. With one instance available, an instance and its correct category remained in view of S until the next instance had been presented, S had responded to it, and had received feedback. The criterion for learning was 20 consecutive correct categorizations. If S had not reached criterion when 140 stimuli had been presented, the program was terminated.

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Insert Table 1 about here

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## Results and Discussion

The means, standard deviations, and reliabilities of the six memory measures and the Repeated Instances (RI) measure are reported in Table 1.

A multiple correlation analysis of the RI measure with the six memory measures as predictors indicated that success in recalling previously presented instances and their correct categorization was most closely associated with the measure of memory for symbolic implications. With all six memory measures used to predict scores on the RI measure, the multiple-correlation coefficient was only .45 ($p = .06$) as compared to the highest bivariate correlation of .35 ($p < .01$) between the measure of memory for symbolic implications (MSI) and RI. This result is not surprising in view of the nature of the stimuli and response system used in the concept learning task. In the task, Ss must learn to associate category labels with stimuli. If dimension selection rules similar to those outlined earlier were employed, it would be necessary to recall not only a stimulus but the correct category associated with it as well. This type of recall is involved in the measures of memory for implications, i.e., S must recall associations he has previously studied. That memory for symbolic rather than semantic implications is most highly related to repeated instances would be expected on the basis of similar content between the test and the concept task. Both the test and the task dealt with associations between numbers and letters. It is probable that a memory for implications or associations ability would be important in multiple-category problems, although the content

of the related measures might be expected to vary with the content of the concept stimuli and response system.

A *t* test for trials-to-criterion revealed no difference between zero and one past instance available, $t(58) = 1.25$, $p = .21$. Thus, providing a previously presented instance did not significantly facilitate performance in the concept task. This result does not appear to be consistent with the results of previous studies. However, previous investigations of the effect of availability upon performance in multiple-category concept problems have had, as a lower limit, one instance available per category. This would provide *S* with a total number of instances equal to the number of categories in the problem. In the present study, only the just previous instance, regardless of its category designation, was made available. This represents a minimum number of available instances and is well below the lower limit on available instances thus far employed.

To evaluate the role of memory under the respective availability conditions, separate multiple-correlation analyses were computed with the six memory measures predicting trials-to-criterion. Within the group with zero instances available, it would be expected that the ability to recall past instances would be of greater importance to successful performance than when an instance was available. For the zero availability group, the multiple-correlation coefficient was .66 ($p < .05$), with the bivariate correlation between MSI and trials-to-criterion equal to -.53 ($p < .01$). Although the MSI measure had the highest correlation, all of the memory measures correlated negatively with trials-to-criterion, indicating that higher memory ability is reflected by more successful performance in the concept task (see Table 2).

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Insert Table 2 about here

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If the availability of a past instance can legitimately be interpreted as a reduction in the memory requirement of the concept task, then a reduction in the association between the MSI measure and trials-to-criterion should occur for the group with one past instance available. The correlation between these two measures within this condition was .15 which represents not only a reduction in the role of MSI but a reversal in the character of the relationship, although the magnitude was not significant. In fact, five of the six memory measures correlated positively with trials-to-criterion; however, none was significant (see Table 2). Only the measure of memory for semantic classes retained any substantial negative correlation with trials-to-criterion. Unlike the other measures, this test has previously been shown to be related to an ability other than the one designated within this study. Dunham, Guilford, and Hoepfner (1966) found that this test was related to a cognition of semantic classes ability, i.e., the ability to recognize the common properties of sets of items. Since providing the available instances allowed Ss to use rules in dimension selection by a direct comparison of the instances available to him, it is reasonable that the ability to recognize the common properties of these instances would be important to the solution of the task.

In conclusion, the ability to recall previously presented instances was most closely identified with a memory for units and implications factor. Although making a previous instance available did not effect differences in mean performance, it did reduce the importance of certain memory abilities in

the concept learning task. The results of this study support the contention that making past instances available reduces the memory requirement in concept tasks. However, it appears that there may be more than one type of memory ability demanded in the solution of multiple-category problems and providing available past instances may not reduce the requirement of all of these types of memory abilities. In addition, there is a suggestion that the roles of other ability variables are being altered by a manipulation which has been primarily regarded only as a manipulation of the memory requirement. Providing past instances may not only reduce a memory requirement, but also create new ways by which S can attain solution that have aspects demanding different tyeps of abilities.

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## Footnotes

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2. Paper presented at the annual meeting of the American Educational Research Association, Los Angeles, February, 1969.

Table 1

Means, Standard Deviations, and Reliabilities of the Six Memory Tests and the Repeated Instances Measure

| Name and Identification of Test | Mean | S. D. | Reliability[a] |
|---|---|---|---|
| 1. Recalled Words (Memory for Semantic Units, MMU) | 25.63 | 4.29 | .71 |
| 2. Memory for Nonsense Word Classes (Memory for Symbolic Classes, MSC) | 13.90 | 5.13 | .83 |
| 3. Paired-Associates Recall (Memory for Semantic Implications, MMI) | 16.45 | 5.35 | .82 |
| 4. Classified Information (Memory for Semantic Classes, MMC) | 53.80 | 5.04 | .42 |
| 5. Number-Letter Associations (Memory for Symbolic Implications, MSI) | 13.42 | 4.95 | .73 |
| 6. Memory for Listed Nonsense Words (Memory for Symbolic Units, MSU) | 51.65 | 6.06 | .65 |
| 7. Repeated Instances | 6.35 | 2.20 | .71 |

[a]All reliability estimates are based on the Spearman-Brown estimate of whole-test reliability from separately timed halves except for Repeated Instances for which scores on odd and even items were used.

Table 2

Correlations of Memory with Trials-to-Criterion for Groups with Zero and One Instance Available

| Tests | Trials-to-Criterion | |
|---|---|---|
| | Zero | One |
| 1. Recalled Words (MMU) | -.28 | .28 |
| 2. Memory for Nonsense Word Classes (MSC) | -.21 | .06 |
| 3. Paired-Associates Recall (MMI) | -.11 | .18 |
| 4. Classified Information (MMC) | -.07 | -.31 |
| 5. Number-Letter Association (MSI) | -.53 | .15 |
| 6. Memory for Listed Nonsense Words (MSU) | -.33 | .03 |